



GRADE 4 SUPPLEMENT

Set E1 Data Analysis: Probability & Technology

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Skills & Concepts

- ★ describe events as likely or unlikely and discuss the degree of likelihood using such words as *certain*, *equally likely*, and *impossible*
- ★ predict the probability of outcomes of simple experiments and test the predictions
- ★ collect data using observations and experiments
- ★ propose and justify conclusions and predictions that are based on data

Bridges in Mathematics Grade 4 Supplement

Set E1 Data Analysis: Probability & Technology

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Bridges in Mathematics is a standards-based K–5 curriculum that provides a unique blend of concept development and skills practice in the context of problem solving. It incorporates the Number Corner, a collection of daily skill-building activities for students.

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Set E1 ★ Activity 1



ACTIVITY

Introducing Virtual Spinners

Overview

During this activity you'll go online with the class to introduce a virtual spinner that can be set up in a variety of ways. Today, you and the students will set up a spinner that's half purple and half yellow. Then students will work in pairs to conduct and record the results of an experiment with the spinner.

Skills & Concepts

- ★ describe events as likely or unlikely and discuss the degree of likelihood using such words as *certain*, *equally likely*, and *impossible*
- ★ predict the probability of outcomes of simple experiments and test the predictions
- ★ collect data using observations and experiments
- ★ propose and justify conclusions and predictions that are based on data

You'll need

- ★ Half & Half Spinner Trials (pages E1.4 and E1.5, run a class set)
- ★ computer(s)
- ★ access to the Internet (see Advance Preparation)
- ★ computer projection equipment (optional)

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Advance Preparation Utah State University has developed a library of free virtual manipulatives that includes a spinner feature that's fun and easy to use. You'll need to familiarize yourself with their web site and the spinner before you teach the activity. To do so, go to <http://nlvm.usu.edu>. Click on Data Analysis and Probability, and select Spinners. When the Spinners feature comes up, click on the "Instructions" button in the top right-hand corner and follow the directions to explore this virtual manipulative.

Note If you have the capacity to project the computer screen, you can conduct this activity with your whole class at the same time. If not, plan to work with small groups, as time allows.

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Instructions for Introducing Virtual Spinners

1. Explain to students that you're going to introduce a web site that will enable them to do spinner experiments on the computer. Have them sit where they can see the screen and demonstrate how to access the Virtual Manipulatives web site. Then show them how to open Spinners.
2. When you reach the Spinners screen, take a few minutes to demonstrate how to spin the spinner and how to change the number and color of regions on the spinner.
3. Then work with input from the class to set up a spinner that's half purple and half yellow. Ask students to pair-share the probability of landing on purple if you spin the spinner just once. Invite volunteers to share their thinking with the class.

Students *You have half a chance because the spinner is half purple. It's 50-50. You can either land on purple or on yellow because they're equal.*

Activity 1 Introducing Virtual Spinners (cont.)

4. If students don't mention the term *equally likely*, explain that purple is *equally likely as* yellow to come up on one spin. One half, 50-50, and 1 out of 2 are other ways of expressing the theoretical probability of getting purple (or yellow) on a single spin. Spin the spinner once. What happens?

5. Now click on the Record Results button so the bar graph is visible. Ask students to make conjectures about the results of spinning the spinner 10 times. Because the spinner is half purple and half yellow, some may hypothesize that the spinner will land on purple 5 times and yellow 5 times. Others may think that you're more likely to get more of one color than the other.

6. Explain that although the chances of getting one color or the other are equally likely on a *single spin*, it's possible to get one of the colors several times in a row if you're making a series of spins. In fact, it's possible, though not likely, to get purple 10 times in 10 spins, even though the spinner is half yellow. Ask students to help you list all the possible outcomes of 10 spins on the board.

Our spinner is half purple and half yellow.
What are all the possible outcomes of 10 spins?

- 0P, 10Y
- 1P, 9Y
- 2P, 8Y
- 3P, 7Y
- 4P, 6Y
- 5P, 5Y
- 6P, 4Y
- 7P, 3Y
- 8P, 2Y
- 9P, 1Y
- 10P, 0Y

7. Invite 10 different volunteers to click the Spin button. Then discuss the data displayed on the bar graph screen.

Students *I thought purple was going to win because it got 3 spins right away, but then yellow caught up and it just kept going.*

In all, we got 3 purples and 7 yellows. Can we try it again?

8. Click the Clear button on the bar graph screen. Then repeat step 7 and record the results of both sets of 10 spins on the board.

3P, 7Y
6P, 4Y

9. Ask students to pair up or assign partners. Explain that you're going to have them continue this experiment on their own. Give each pair a copy Half & Half Spinner Trials, and have them put their names on the sheets. Review the instructions with the class and spend a little time discussing students' conjectures before they get started.

Teacher *Which outcomes do you think you'll get most and which least if you do 20 sets of 10 spins, and why?*

Activity 1 Introducing Virtual Spinners (cont.)

Students *We should get 5 and 5 the most because the spinner is half and half. I don't think it's all that easy to get 5 and 5. I think maybe we'll get 6 and 4 or 4 and 6 the most. You just hardly ever get exactly 5 and 5 with spinners like that. You can get almost anything, but I don't think we're going to get all purples or all yellows. That just seems kind of impossible.*

10. Ask student pairs to complete questions 1–4 right now and to finish the rest of the assignment as access to computers allows.

Extensions

- When all the pairs have completed their sheets, pool and discuss the class data. What outcomes came up the most frequently? Which came up least? Encourage students to reflect on their results and explain them the best they can.
- Have students use the Bar Chart feature on the NLVM web site to create and print out a graph of their own data, or even the pooled data from the whole class. They might set up the graph with 3 columns: More Purple than Yellow, Equal Number of Purple and Yellow, More Yellow than Purple. The Bar Chart feature includes a place to title the graph and label the columns.

NAME _____

DATE _____

Half & Half Spinner Trials

page 1 of 2

Directions:

- Go to the Virtual Manipulatives web site at <http://nlvm.usu.edu>
- Click on Data Analysis & Probability.
- Click on Spinners.
- When you get to Spinners click the Change Spinner button and set up a spinner that's half purple and half yellow by setting Yellow and Purple each to 1 and the other fields to 0.
- Click the Record Results button, and drag the 2 screens apart so you can see your spinner and the bar graph at the same time.
- You and your partner are going to do 20 sets of 10 spins. All the possible outcomes of spinning the spinner 10 times are listed on the chart below. Read and answer questions 1–4 on the next page *before* you start spinning. Then read item 5 for more instructions.

Possible Outcome	How many times did you get this outcome?
0 Purples / 10 Yellows	
1 Purple / 9 Yellows	
2 Purples / 8 Yellows	
3 Purples / 7 Yellows	
4 Purples / 6 Yellows	
5 Purples / 5 Yellows	
6 Purples / 4 Yellows	
7 Purples / 3 Yellows	
8 Purples / 2 Yellows	
9 Purples / 1 Yellow	
10 Purples / 0 Yellows	

NAME _____

DATE _____

Half & Half Spinner Trials page 2 of 2

- 1** Before you start spinning, put stars beside the two outcomes on the chart you think you'll get most often. Record them in the space below also.

- 2** Explain your answer. Why do you think you'll get those outcomes the most?

- 3** Now circle the two outcomes on the chart you think you'll get *least* often. Record them in the space below also.

- 4** Explain your answer. Why did you circle the 2 outcomes you did?

- 5** Now start spinning. Stop at the end of 10 spins and record the outcome on the chart on the previous page. When you're finished, click the Clear button on the bar graph screen and start over. Record the outcome of each set of 10 spins on the chart until you've done 20 sets of spins. *Be sure to click the Clear button after each set.*
- 6** Which outcome did you get the most? Which outcomes came in second and third place?

- 7** List at least 3 other observations about your results below.

- 8** How well did your results match what you thought was going to happen? Why do you think this experiment turned out the way it did?

Set E1 ★ Activity 2



ACTIVITY

Another Virtual Spinner Experiment

Overview

Using the virtual spinner introduced in Set E1 Activity 1, student pairs will set up a spinner that's three quarters one color and one quarter another. Then students conduct and record the results of an experiment with their spinner.

Skills & Concepts

- ★ describe events as likely or unlikely and discuss the degree of likelihood using such words as *certain*, *equally likely*, and *impossible*
- ★ predict the probability of outcomes of simple experiments and test the predictions
- ★ collect data using observations and experiments
- ★ propose and justify conclusions and predictions that are based on data

Recommended Timing

Anytime after Set E1 Activity 1

Instructions for Another Virtual Spinner Experiment

1. Review with the class the procedures for getting to the Spinners feature on the Virtual Manipulatives web site introduced in Set E1 Activity 1.
2. When you've reached the Spinners screen, work with input from the class to set up a spinner that's $\frac{3}{4}$ green and $\frac{1}{4}$ orange. Ask students to pair-share the probability of landing on green or orange if you spin the spinner just once. Invite volunteers to share their thinking with the class.

Students *You have a way better chance of landing on green because it fills up more than half the spinner.*

It's not all that likely to get orange because it's only one-fourth of the spinner.

3. If students don't mention the terms *more* and *less likely than*, explain that green is more likely than orange to come up on one spin, and orange is less likely than green to come up. Three-fourths, 75%, and 3 out of 4 are other ways of expressing the theoretical probability of getting green on a single spin. One-fourth, 25%, and 1 out of 4 are other ways to express the theoretical probability of getting orange on a single spin. Spin the spinner once. What happens?

4. Now click on the "Record Results" button so the bar graph is visible. Ask students to make conjectures about the results of spinning the spinner 12 times. Because the spinner is three-fourths green and

You'll need

- ★ Another Virtual Spinner Experiment (pages E1.10 and E1.11, class set)
- ★ computer(s)
- ★ access to the Internet (see Advance Preparation)
- ★ computer projection equipment (optional)

Advance Preparation See Set E1 Activity 1 Advance Preparation notes.

Note If you have the capacity to project the computer screen, you can conduct this activity with your whole class at the same time. If not, plan to work with small groups, as time allows.

Activity 2 Another Virtual Spinner Experiment (cont.)

one-fourth orange, some may hypothesize that the spinner will land on green 9 times and on orange 3 times. While these figures reflect $\frac{3}{4}$ and $\frac{1}{4}$ of 12, remind students that the results of experiments don't always match the theoretical probabilities.

5. Ask students to help you list all the possible outcomes of 12 spins on the board.

Our spinner is $\frac{3}{4}$ green and $\frac{1}{4}$ orange.
 What are all the possible outcomes of 12 spins?

- 0G, 12O
- 1G, 11O
- 2G, 10O
- 3G, 9O
- 4G, 8O
- 5G, 7O
- 6G, 6O
- 7G, 5O
- 8G, 4O
- 9G, 3O
- 10G, 2O
- 11G, 1O
- 12G, 0O

6. Change the number of spins on the spinner screen to read 12 instead of 1 and have a volunteer click the Spin button. What happens?

Students Cool! It did all 12 spins really fast!

It came out 8 greens and 4 oranges. I knew it would come out more green.

Do it again!

7. Click the Clear button on the bar graph screen. Then repeat step 6 and record the results of both sets of 12 spins on the board.

8G, 4O
9G, 3O

8. Ask students to pair up or assign partners. Explain that you're going to have them continue this experiment on their own. Give each pair a copy of Another Virtual Spinner Experiment, and have them put their names on the sheets. Review the instructions with the class and spend a little time discussing students' conjectures before they get started.

Teacher Which outcomes do you think you'll get most if you do at least 25 sets of 12 spins, and why?

Students I think we'll get 9 and 3 the most because 9 is $\frac{3}{4}$ of 12 and 3 is $\frac{1}{4}$ of 12.

I think it'll be like last time. We won't get the exact thing every time, but we'll get stuff close to it, like 8 and 4, and maybe 10 and 2.

We'll definitely get more of the color that takes up $\frac{3}{4}$ of the spinner. We're going to make ours red and blue.

9. Ask student pairs to complete questions 1–3 right now and to finish the rest of the assignment as access to computers allows.

Activity 2 Another Virtual Spinner Experiment (cont.)

Extensions

- When all the pairs have completed their sheets, pool the class data and discuss it. What outcomes came up the most frequently? Which came up least? Encourage students to reflect on their results and explain them the best they can.
- Have students use the Bar Chart feature on the NLVM web site to create and print out a graph of their own, or even the pooled data from the whole class. They might set up the graph to show how many times they got the 3 or 4 most frequent outcomes. The Bar Chart feature includes a place to title the graph and label the columns.



INDEPENDENT WORKSHEET

See Set E1 Independent Worksheet 1 for another probability experiment that enables students to explain and record their observations using technology.

NAME _____

DATE _____

Another Virtual Spinner Experiment page 1 of 2

Directions:

- Go to the Virtual Manipulatives web site at <http://nlvm.usu.edu>
- Click on Data Analysis & Probability.
- Click on Spinners.
- When you get to Spinners click the Change Spinner button and set up a spinner that's $\frac{3}{4}$ one color and $\frac{1}{4}$ another. You can choose your own colors this time.

1 List all the possible outcomes in the left-hand column on the chart below. Use abbreviations for your colors if you want, but be sure to list the outcomes in order. There should be 13 of them because you will make 12 spins each time.

Possible Outcome	How many times did you get this outcome?
12 _____ + 0 _____	
11 _____ + 1 _____	

NAME _____

DATE _____

Another Virtual Spinner Experiment page 2 of 2

- 2** Before you start spinning, put stars beside the three outcomes on the chart you think you'll get most often. Record them in the space below also.

- 3** Explain your answer. Why do you think you'll get those outcomes the most?

- 4** Click the Record Results button on the spinner screen, and drag the 2 screens apart so you can see your spinner and the bar graph at the same time. On the spinner screen, change the number of spins from 1 to 12 spins.

- 5** Click the Spin button and watch what happens. Record the outcome on your chart. Then click the Clear button on the bar graph screen and start over. Repeat this at least 25 times, more if you have time. *Be sure to click the Clear button after each set.*

- 6** Which outcome did you get the most? Which outcomes came in second and third place?

- 7** List at least 3 other observations about your results below.

- 8** How well did your results match what you thought was going to happen? Why do you think this experiment turned out the way it did?

NAME _____

DATE _____

Set E1 ★ Independent Worksheet 1



INDEPENDENT WORKSHEET

The 6–4–2 Spinner

Directions:

- Go to the Virtual Manipulatives web site at <http://nlvm.usu.edu>
- Click on Data Analysis & Probability.
- Click on Spinners.
- When you get to Spinners, click the Change Spinner button. That will take you to the Spinner Regions screen. Set up the regions so there are 6 yellow, 4 blue, and 2 green, and then click Apply.

1 Tell what fraction of the spinner turned out to be each color. (Hint: If you're not sure when you look at the spinner, get 6 yellow, 4 blue, and 2 green tile. Use the tile to help you figure out the fractions for each color.)

a The spinner is _____ yellow.

b The spinner is _____ blue.

c The spinner is _____ green.

2 What color do you think the arrow will land on if you spin the spinner 1 time? Explain your answer.

3 Click the Spin button once. What color did the arrow land on? _____

4 Which color do you think will come up most often if you make 100 spins? Why?

5 Which color do you think will come up least often if you make 100 spins? Why?

(Continued on back.)

Independent Worksheet 1 The 6–4–2 Spinner (cont.)

6 About how many times do you think you'll get each color if you spin the spinner 100 times? Explain your answers.

a I think I'll get yellow about _____ times because

b I think I'll get blue about _____ times because

c I think I'll get green about _____ times because

7 Click the Record Results button on the spinner screen, and drag the 2 screens apart so you can see your spinner and the bar graph at the same time. On the spinner screen, change the number of spins from 1 to 100 spins.

8 Click the Spin button and watch what happens. Record the outcome on the chart below. Then click the Clear button on the bar graph screen and start over. Do the experiment 10 times and record the data on the chart. *Be sure to click the Clear button after each set.*

Yellow	Blue	Green

(Continued on next page.)

NAME _____

DATE _____

Independent Worksheet 1 The 6–4–2 Spinner (cont.)

9 List at least 3 observations about your data.

10 How well did your results match what you thought was going to happen?
Why do you think this experiment turned out the way it did?

